

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**

**GRASSED WATERWAY**

(Ac.)

**CODE 412**

**DEFINITION**

A shaped or graded channel that is established with suitable vegetation to carry surface water at a non-erosive velocity to a stable outlet.

**PURPOSE**

- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- To reduce gully erosion.
- To protect/improve water quality.

**CONDITIONS WHERE PRACTICE APPLIES**

In areas where added water conveyance capacity and vegetative protection are needed to control erosion resulting from concentrated runoff. This practice also applies to stone centered waterways.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Plan, design, and construct grassed waterways to comply with all Federal, State, and local laws and regulations.

**Capacity.** The minimum capacity shall convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Capacity shall be increased as needed to account for potential volume of sediment expected to accumulate in the

waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. At a minimum, the design capacity shall remove the water before crops are damaged.

**Stability.** Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 7, Grassed Waterways; Agricultural Research Service (ARS) Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels; or other equivalent method.

Design velocities should not exceed the maximum permissible velocities for soils as specified in Section II of the Field Office Technical Guide.

If the capacity and velocity of the waterway is such that vegetation will not resist the tractive stresses (the design velocity exceeds the allowable velocity for vegetation or stone center), then the waterway shall be designed according to (Code 468), Lined Waterway or Outlet.

**Width.** Keep the bottom width of trapezoidal waterways less than 100 feet unless multiple or divided waterways or other means are provided to control meandering of low flows.

**Side slopes.** Keep the side slopes flatter than a ratio of two horizontal to one vertical. Accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment that will cross the waterway in the designed width.

**Depth.** The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

Provide freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

**Drainage.** When needed to help or keep vegetation established on sites having prolonged flows, high water tables, or seepage problems, include Subsurface Drains (Code 606), Underground Outlets (Code 620), stone center waterways or other suitable measures in waterway designs. Drainage systems shall comply with all federal, state, and local wetland laws and regulations.

**Outlets.** Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

**Vegetative Establishment.** Grassed waterways shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting (Code 342). Species selected shall be suited to the current site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop,

rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment.

**Stone Center.** A stone center can be installed in grassed waterways to drain prolonged wetness or if the velocity is slightly higher than what is allowable for the proposed grassed waterway. The allowable velocity of the soil may be increased by 2.0 ft/sec if a stone center is properly installed. Gravel bedding or filter fabric may need to be installed under the stone to prevent erosion of the underlying soil. The stone center shall be no less than 1/3 the total width of the waterway and no more than 2/3 the total width. The required rock size in relation to grade of the waterway and depth of flow can be determined from the nomograph.

**Waterway Protection from Livestock.** When livestock have access to the waterway, limit access according to a controlled grazing system to protect the waterway, or use fences to exclude the livestock from the waterway.

## CONSIDERATIONS

In the absence of precise field data regarding the height and stem density of the vegetation, it is acceptable to design based on retardance classes. For Capacity (longest and densest cover), generally use class B or C. For Stability (shortest and sparsest cover), generally use class D.

Establish an appropriate width of vegetation on one or both sides of the waterway or add other sediment control measures above the waterway such as residue management to improve water

quality and reduce sediment deposition in the waterway. Consider increasing the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce the amount of sediment that leaves a field. Be sure to provide for regular cleaning out the waterway when trapping sediment in this manner.

If necessary for obtaining good vegetative cover, the topsoil may be saved and spread in the constructed waterway, or chopped sod to the center 2/3 of the waterway. Where this is done over excavate the waterway to allow for the placement of topsoil/sod without encroaching on the design cross section.

Use a biodegradable Erosion Control Blanket (ECB) during the establishment period to stabilize the waterway. ECB shall be installed according to manufacturer's specifications. At a minimum the erosion control matting shall be installed along the center one third of the waterway width for the entire length. Erosion control matting along stone centered grassed waterways is not required unless matting is necessary to prevent erosion along the edge of the stone center.

Avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where areas cannot be avoided, seek recommendations from a soil scientist for ameliorating the condition or, if not feasible consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.

Avoid or protect if possible important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterway. If trees and shrubs are incorporated, they should be retained

or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select species of vegetation that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

Add width of appropriate vegetation to the sides of the waterway for wildlife habitat.

Consider including diverse legumes or other forbs that provide pollen and nectar for native bees. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer.

The construction of a grassed waterway can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

## **PLANS AND SPECIFICATIONS**

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice

according to this standard. As a minimum the plans and specifications shall include:

- A plan view of the layout of the grassed waterway and all system components.
- Typical cross sections of the grassed waterway(s).
- Profile(s) of the grassed waterway(s).
- Details of the outlet protection (see documentation requirements for companion practices if necessary).
- Details of special features and appurtenant devices.
- Relevant soils and vegetation data including allowable velocities, soil erodibility and vegetal cover factor.
- Disposal requirements for excess soil material.
- Site specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements including seedbed preparation, time of seeding, mixture rate, stabilizing crop, mulching, or mechanical means of stabilizing, fertilizer, and lime requirements for the applicable area.

## **OPERATION AND MAINTENANCE**

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan.

- Establish a maintenance program to maintain waterway capacity (original width and depth), vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization such as silt fences, mulching, haybale barriers and etc. to stabilize grade during vegetation establishment.

- Where cultivation operations are adjacent to the waterway, align tillage and row directions perpendicular to the grassed waterway to allow surface drainage into the waterway and to prevent flows along the edges. Avoid using waterways as turn-rows during tillage and cultivation operations. Lift tillage equipment and turn off sprayers when crossing the waterway.
- When livestock have access to the waterway, limit access to the waterway according to a controlled grazing system, especially during wet periods, or install and maintain fences to exclude the livestock from the waterway.
- Inspect grassed waterways regularly for eroding areas (rills and gullies), bare ground, or other damage, especially following heavy rains. Fill, compact, and reseed damaged areas immediately.
- Remove sediment deposits to maintain capacity of grassed waterway.
- Avoid use of herbicides that would be harmful to the vegetation in and adjacent to the waterway area.
- Avoid using waterways as turn-rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. Mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Maintain capacity and function of waterway outlet per design and/or in accordance with companion practice requirements.

## **REFERENCES**

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 2, Estimating Runoff. USDA, NRCS. 2007.

USDA, NRCS. 2007. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed Waterways

Engineering Field Tools, Waterway Design Tool (EFT-WDT), Computer program for Designing Grassed Waterways, USDA, NRCS.